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# SECOND ANNUAL DATE GROWER'S INSTITUTE

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## The Fertilization of Fruit Trees

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THE fertilizer situation is becoming more hopeful in at least one respect. Five or ten years ago our soil experts believed that fertilization was altogether a local problem and that the only method by which the farmer might find out for himself the proper fertilizers to use was by means of small local tests. Today they tell you that there are indications coming from fertilizer tests all over the United States and abroad, to show that we are about to arrive at some general underlying principles in the fertilization of all crops. It will be my purpose in this discussion to present what we know and what we do not know concerning the fertilization of fruit trees.

### Popular Fallacies

Before getting into the subject proper, however, I propose to discuss three popular fallacies. The first of these has to do with the value of soil analysis. There are still many persons who believe, in any event state they do, that it is possible or should be possible for a competent chemist to tell the grower what crop can be grown on his soil, or the fertilizer his particular soil requires, by means of a soil analysis. Neither of these claims is correct. Neither is based on fact. All plants have certain plant food requirements. There are twelve or thirteen elements now that are regarded as being essential to all plants. Some of them are used in such minute amounts that the most delicate tests we have indicate only a trace; nevertheless they are essential.

We know that the essential mineral elements are present in most soils and in sufficient amount. We do not know of any method as yet however that will tell in what quantities these exist in our soils in form available for plant use. There are soils which show a high content of certain plant food elements, yet respond notably to applications of the same elements. The presence in the soil of any particular element therefore is not proof that it is available to the plant. And so we find that soil analysis does not give us much help in our fertilizer problems. About its only value is to indicate the presence or absence of certain salts, nitrates and other, and especially certain highly soluble salts popularly referred to as alkalis. So when someone tells you he can tell you from a soil analysis what fertilizer to put on, you may know that such is not possible. This is the general attitude of our soil experts today.

With respect to the crops you can grow on a given soil, obviously of far more importance than the soil itself is the climatic environment. The date is an excellent example of this fact. It isn't the soil that determines whether the date is successful. It is the heat units which determine that point. And practically every crop has similar environmental limitations. So we can also dispose of that fallacy. It must be admitted, however, that large sums have been paid for soil analysis, from which

the growers have realized little or no benefit whatever.

And now for the second fallacy—the complete fertilizer. What is a complete fertilizer? The standard trade definition is one that contains nitrogen, phosphorus and potassium. But why should such a fertilizer be regarded as complete? It certainly does not include all the plant nutrients we know are required. Further, we have little justification for assuming that these three are necessarily more important than the others, with the exception that we know nitrogen to be the key element in fertilization. But plants must have sulphur; they must also have calcium, and certain other mineral elements. The citrus tree, for instance, in the absence of calcium shows a more marked injury than is the case in the absence of any other element. Yet the so-called complete fertilizer may not contain calcium. Consequently the idea of a tree element fertilizer being complete is no longer tenable. We must take care of all plant nutrient requirements.

A word or two concerning the third fallacy—that of feeding the plants a "balanced ration." Much is said today about the similarity between plants and animals. The livestock producer and the poultryman know that it pays to feed balanced rations. The orchardist is told that in like manner it pays to feed his trees balanced rations. The analogy as commonly made is altogether incorrect, although there is an important and perhaps fundamental analogy be-

tween the nutrition of plants and animals.

The balanced rations in animal and human nutrition consists of a ratio between two groups of substances or food stuffs, the proteins and the carbohydrates. The essential constituent of all proteins is nitrogen and the proteins are considered to be initial stages in the development of the living substance or protoplasm, this being regarded as a combination of highly complex proteins. The essential constituent of the carbohydrates gives them their name, and is carbon, the element which as Dr. Faries stated, is taken in through the leaves and transformed there from inorganic carbon to the organic form of carbohydrates. We have long known that in animal and human nutrition we get the best results from certain definite ratios between the proteins and carbohydrate, this having been determined from feeding experiments. That is what the balanced ration means in human and animal nutrition.

Now what is the situation in plant nutrition? The same analogy applies, only the plant absorbs its nutrients from both ends. It takes in certain materials through the roots, but far more in bulk through the leaves. The leaves absorb the carbon and manufacture it into carbohydrates, the principal foodstuff we feed our animals. The principal nutrient absorbed by the roots is nitrogen, from which the proteins are manufactured. The plant handles its food in simple form in contrast with the animal. Thus we see the true analogy between plants and animals with respect to the balanced ration. We do not feed the plant a balanced ration since its carbon is taken from the atmosphere.

The carbon-nitrogen ratio in plants, however, is a matter of the greatest importance. Plant physiologists have found that if there is a deficiency in the carbon intake the plant is unhealthy—does not grow properly and does not fruit. If the nitrogen intake is deficient the plant does not grow properly nor does it set a desirable amount of fruit. If, however, there is a surplus of carbohydrates manufactured in the leaves—which obviously requires a relatively large healthy leaf surface exposed to the sunlight and a sufficiency of nitrogen, the plant grows normally and is fruitful. If there is a surplus or more than enough nitrogen taken up to take care of the normal needs of the plant the result is vegetative growth and lack of fruit bearing. We find

therefore that by excessive pruning the plant is changed from a condition of fruitfulness to one of vegetative growth. This has been shown to apply to the citrus fruits and to the deciduous fruits; it also applies to the vegetables. I know of no reason why it should not apply to the date, in fact there is much evidence to indicate that it does.

If this be true, what then should be the basic fertilizer for the grower to apply? The answer you already have—namely nitrogen. From these considerations we come, therefore, to one essential element—nitrogen—and in addition organic matter, essentials in the fertilization of most of our soils.

#### Deciduous Fruit Fertilization

Now to review briefly what we know about the fertilization of the walnut and the stone fruits. Much time has been devoted to the fertilization of these fruits by the eastern Experiment Stations, much less to a study of them in California. Thus far the only definite results obtained in the fertilization of the peach, apricot, apple and pear in California are that where increases in yield have been noted they have been invariably from the use of nitrogen, and to be exact, from quickly available nitrogen,—dried blood, sulphate of ammonia, fish meal, etc. Dr. Batchelor has experimented with the walnut, a crop of considerable importance in California, and from tests running seven or eight years has derived the following conclusions:

First, a positive increase in yield resulting from the use of nitrogen, and second, absolutely no results from the use of phosphorus or potassium in addition to nitrogen. But the cost of labor and fertilizers has been more than the value of the increase in the yield. Therefore, so far as we know, it is not an economic practice to use fertilizers on the walnut.

But perhaps there is a reason for this situation in the fact that we always select the best and deepest soils for walnut plantings. We know the walnut is one of the deepest rooted plants we have, the roots normally going to depths of twelve to fifteen feet, sometimes much deeper. We would, therefore, have reason to expect it might do without fertilization longer than any other fruit crop.

#### Citrus Fruit Fertilization

The citrus fruits, however, constitute a group concerning which we do have definite information, probably more than is the case with any other fruit grown in the United States. We have been studying the

fertilization of citrus trees for about twenty years at the Citrus Experiment Stations. We have learned that we must fertilize citrus trees if satisfactory crops are to be produced. Indeed it is now almost an axiom in successful citrus culture that one must fertilize. It is not possible to make this statement about any other fruit crop grown in the United States. In some localities it is known that fertilization of the apple pays, but taking the country as a whole there is some question as to whether it pays. And the same is true with reference to the other fruit. But we know definitely that citrus trees must be fertilized,—in Florida, Texas, Arizona, California, and everywhere else. We know also that two things are essential, nitrogen and organic matter. Nothing else that has been tested and no other plant food element, no matter what the combination, has given positive improvement in yield or tree health, save only organic matter and nitrogen. Since the former invariably contains the latter, so as far as we know the only plant food element that gives positive and beneficial effects is nitrogen. We have learned further that under average price conditions (price of fruit and price of nitrogen) the use of two hundred to two hundred and fifty pounds of nitrogen per acre per year given the best results. It is not safe, however, to assume that the date would require this amount although the chances are that it might.

We know also that it makes little difference what source of nitrogen is used, dried blood, ammonium sulphate, or barnyard manure—provided the amounts are the same and provided further it is applied in such a manner and at such a time that it is released to the plant in equal amounts. In other words, cottonseed meal, if applied a certain number of weeks in advance in sufficient quantities to give a pound of nitrogen per tree, gives the same result as calcium nitrate, yielding the same amount, applied four or five days in advance of the time the tree needs it. There is, therefore, no one best source of nitrogen. Dried blood is not the best, calcium nitrate is not the best. We know, further, that this nitrogen must be applied for best results in a combination of bulky organic form, to furnish organic matter, and in the concentrated form to furnish material more quickly available to the plant. Our observations, including many hundreds of orchards and some forty-five or fifty tests, indicate that a satisfactory program is

half the nitrogen from bulky organic sources, and the other half from concentrates. That is to say, if two hundred pounds of nitrogen is to be used, one hundred pounds should be from bulky organics, the remainder from concentrates.

We know that in general there are two groups of nitrogenous fertilizers as regards availability, those that are readily or more quickly available, and those more slowly available. The first group includes the inorganics, (nitrate of soda, nitrate of lime and sulphate of ammonia) and the high-grade organics (dried blood, fish meal, cotton seed meal, and others). Examples of bulky organics are manure, bean straw, alfalfa hay, etc. The practical importance of these two groups relates to their relative availability to the trees and consequently the time when they should be applied. The period when the citrus tree experiences its maximum nitrogen requirement is during the spring and early summer months and the greatest requirement occurs just at the time the blossom buds are being put out in the spring and continues from that period until the setting period is over, approximately February 15 to June 15. After that time the nitrogen requirements are materially lower. That being the case, we must choose our fertilizers and apply them so that they will be available for use at the time when needed. Since barnyard manure takes four months to be available it must be put on not later than November. Nitrate of soda on the other hand takes ten days or so to become available and consequently should be applied about ten days before the bloom.

The slowly available sorts (the bulky organics) should be applied in the fall, the quickly available sorts, inorganics (chemicals) and high grade organics, in the spring. From the point of view of maximum efficiency, conservation of organic matter and of nitrogen, they should be placed deep in the soil. The furrow method of applying manure and bean straw is recommended for occasional use, but we believe that deep plowing is better. The high-grade organics should also be covered, and preferably placed as deep down as possible. The chemical forms can be applied on the surface and carried down by the rainfall, if such occurs. But the safest procedure is to put them down deep also. If you know it is going to rain, however, you can get good results in their use by applying them on the surface, since they are soluble and are easily carried down.

In a young citrus orchard, a good cover crop when nitrogen is twenty-five to thirty cents per pound, is worth from \$20.00 to \$40.00 per acre for the nitrogen it contains. In the older orchard its worth should be computed only on its organic matter content, since the amount of nitrogen in the soil is such that that cover crop does not add nitrogen from the atmosphere. A first class cover crop in a bearing citrus orchard, we believe, is equivalent to three to five tons of barnyard manure.

What tests we have conducted, and they are numerous, indicate that only rarely do we get positive benefits from lime, gypsum or sulphur. Occasionally, we find a case where positive results are obtained but in nine out of ten cases the results are negligible. We recommend, therefore, that these be not applied on the entire acreage but tested first on small plots. Our experience is that as a fertilizer, peat is worthless. The only possible benefits from its use are where one can use enough to change physical conditions of the soil, and obviously the amounts required to do so are prohibitive. Its nitrogen content is unavailable and its organic matter content is worthless for it does not decompose. The only kind of organic matter that is worth while to apply to citrus soils is one which decomposes readily in the soil.

We have learned that in the purchase of fertilizers for citrus trees one can frequently save fifty per cent by buying the cheapest nitrogen and the cheapest organic matter. We have learned to compute the value of the bulky organics such as manure on the unit basis. To illustrate, if alfalfa hay runs two per cent nitrogen, and good nitrogen is worth six dollars a unit, alfalfa is worth twelve dollars a ton for nitrogen. But it is also worth something for organic matter which is today valued at about five cents a unit. If it runs eighty per cent dry weight there will be an additional value of four dollars for the organic matter. Four dollars plus twelve dollars equals sixteen dollars, the value of alfalfa for fertilizer. And yet I have known instances of growers paying twenty-five dollars per ton for it. In general, the chemicals are cheaper than the organics.

Our citrus fertilizer program, therefore, consists of four points. 1. For the first seven or eight years grow cover crops in young orchards, —in the winter, and in the summer if you have sufficient water. 2. From the time they are eight to twelve to fifteen years old, grow winter crops

and add bulky organics to supply two pounds of nitrogen per tree. 3. From that time on apply from two to three pounds of nitrogen per tree—one half from bulky organics and one-half from concentrate sources. 4. For other materials apply them only where tests show benefits.

We know, however, that citrus trees require many more elements than we apply as fertilizers. Most of these exist in the soil, many already in available form, some in unavailable form. Most of the unavailable kinds we find can be made available by using organic matter. Thus the cheapest way to provide phosphorus is to use organic matter. And the cheapest way to add organic matter is to grow a cover crop.

#### General Summary

A general summary of fruit tree fertilization in the United States shows the following:

First, that in many parts of eastern United States it does not pay to fertilize, highly important information. Second, where positive results have been secured, where increase in yield and improvement in growth and tree health have accompanied the use of fertilizers, the results are not always sufficient to warrant the use of fertilizers. In other words, where increases in yield occur it sometimes does not pay to fertilize. That is true of apples and pears in a number of eastern states. Increase in yields have been secured but they do not make up for the cost. Third, where results have been sufficient or more than sufficient to pay for the cost, invariably it has been nitrogen that has brought the results. Fourth, in the western states we find that organic matter always gives positive results. Fifth, what results have been gotten from the use of phosphorus have been in the eastern states in connection with the growth of leguminous cover crops, —bitter clover, alfalfa, etc. The results, therefore, have been indirect. Phosphorus has fertilized the cover crop, and the cover crop has fertilized the trees. Sixth, with rare exceptions, the evidence indicates that potash has failed to give results.

#### Soil Management and Fertilization

There is much evidence to indicate that in all probability many of the eastern fertilizer experiments have failed to produce positive results because the soil management program used has offset the effects of the fertilizers applied. In other words, one may use good fertilizer practice and lose all its value on account of improper soil management.

Six years ago soil management tests were started in Tulare county, using eight different treatments. All the plots received the same amount of fertilizer and of water, but they were plowed and cultivated differently,—the soil management program was different. In one year there were noticeable differences and at the end of five years one treatment showed three hundred per cent more fruit than all others. It is evident, therefore, that the soil management program must supplement the fertilization program or the best results will not be had from either, and that it is possible to negative good fertilization practice by poor orchard management.

I mentioned in the beginning that there is evidence furnished by tests in nearly all parts of the United States—with apples in Washington and New York, peaches in West Virginia, Citrus in Florida and California, in other words, with the different fruits all over the country, to show that there are a few general principles of fruit tree fertilization. While the date is monocotyledonous and in many respects entirely different from the fruits studied, and while we have no data concerning its fertilizer requirements. I shall be greatly surprised if we do not find it be more or less similar to other fruit trees. I think it a good bet it is. That is about where we stand now in the matter of fruit tree fertilization.

#### Plot Layout

If you undertake fertilizer experiments, which is greatly to be desired, there are several precautions that should be borne in mind. The plots should not be too large as the larger they are the greater is the error from soil variation. Plots may also be too small as the smaller they are the

greater is the factor of tree variation. One must strike a happy medium. In the case of standard orchard trees, we find the best size to be from eight to ten trees. Plots of this size are inconvenient to handle in commercial operations. The results are much more accurate, however, than from an acre plot or larger. The plots should be duplicated a sufficient number of times so that when differences of ten per cent are found they are significant. To illustrate, if there is only one plot and a check and the difference in yield is ten per cent, the odds are about five to one, that the difference is not significant. There should always be a check plot to every treated plot. Treated guard rows should also be used, every other row being a fertilizer plot, and the rows in between fertilized on one side but not on the other side.

MR. COOK: Has there been any experiment to determine whether there is any danger of over-fertilization?

PROF. HODGSON: Yes, sir, but thus far they are all negative. That is rather a timely question, however, inasmuch as at the present time there are some large ranch owners that feel that they may have overdone the use on nitrogen. On the basis of nitrate determinations they have from six hundred to eight hundred parts per million of nitrogen in their soil which is large, and they have concluded that it is responsible for the decline of their trees. Our belief is that over-irrigation has caused their troubles. I have seen forty tons of manure per acre applied for five years in succession with no evidence of injury. I have also seen fifteen tons of manure put on one walnut tree and with no evidence either of

benefit or injury. A good many citrus fruit growers use twenty tons per acre and some of them use five pounds of nitrogen in addition. Apparently it hasn't hurt the trees.

A VOICE: How about mottled leaf on citrus?

PROF. HODGSON: We find there is a correlation between the use of large amounts of nitrogen per acre and the percentage of mottled leaf which occurs. We find, also, that there is a positive correlation between the amount of organic matter used per acre and the smallness of amount of mottled leaf. The more nitrogen used the greater the amount of mottled leaf. So if all the nitrogen is added in organic form, there is a minimum of mottled leaf, but if the most of it is applied in chemical form there is the maximum amount of mottled leaf.

A VOICE. What is the best way to apply soluble nitrates?

PROF. HODGSON: Perhaps the ideal method would be the overhead method of irrigation using water containing the nitrogen. The usual way is to distribute them uniformly on the surface and then plow them down, or to distribute them in the irrigation furrows and then run the water on. The better system by far is that which you get with rainfall, and your overhead irrigation is likely just as good. The next best is basin-irrigation. The least efficient—but still reasonably so—is where you put it in the furrows and harrow it in.

A VOICE: Would you say, then, you would use nitrogen in the form of manure, organic matter, or would that cost too much?

PROF. HODGSON: In both forms. An ideal program would be half nitrogen in manure and half of it in concentrates.

# Effects of Soil Fertilization on the Date Palm

BY D. W. ALBERT, DIRECTOR OF GOVERNMENT EXPERIMENT STATION, AT TEMPE, A RIZONA

AS there is at the present time but very little experimental data on the effect of soil fertilization of the date palm in Arizona, in presenting this paper I shall have to deal with the subject almost entirely from somewhat informal observations made during the past few years that I have been connected with this work.

During the year 1918, the Arizona Experiment Station laid out a soil fertilization experiment for the Yuma and Tempe Date Orchards. Just as this experiment was well under way, It was found necessary to defoliate and torch both orchards on account of an infestation of *Parlatoria* scale. Since that time both orchards have

had to be defoliated and torched two and three times. As we feel that our Tempe Orchard, at least, and probably our Yuma Orchard, are entirely free from this insect pest, we have made plans to resume work on the experiment of soil fertilization at an early date.

At the present time neither or-

chard is back to its normal condition. The Tempe orchard was allowed to bear a partial crop during the season of 1923, and a somewhat larger crop during the past year. It will be interesting to note that although but a small amount of fruit was allowed to mature during 1923, a number of the palms that bore heaviest did not bloom during the 1924 season. This was especially true of the Iteema variety—not one palm of which, that bore fruit in 1923, blossomed in 1924. Other varieties that were noticeably thrown out of annual bearing were the Deglet Noor and Rhars. I believe that we can attribute this directly to the weakened condition of the palms, caused by over production during 1923. This same condition might also be caused by allowing a healthy palm to over-bear. The seedling palms located on the University campus have been thrown into alternate bearing for the past three years, on account of our having allowed too heavy a crop of fruit to set. We have brought back two of these palms to annual bearing by cutting off about half of the flowering clusters each year. However, these palms have not received the best of care as they are planted along the drive ways and lawns, and similar results might not develop with palms receiving better care and attention.

There seems to be a common supposition on the part of some people, that the date palm will grow in any kind of soil, regardless of its fertility, alkalinity or type. While this is true to a more or less degree, the relative results obtained from the palm will, within certain limits, be in almost direct proportion to the amount of water applied, the type of soil in which the palm is planted and the efficiency of soil management. Perhaps this conclusion has been drawn from the fact that in our orchard located at Tempe, Arizona, the palms are growing in soil in which the water table has stood within 18 inches of the surface of the soil for a number of years, and the ground is so incrustated with alkali salts that to walk through the orchard during the summer months, when the evaporation from the soil is highest, would remind one of walking over frozen snow. The surface of the ground is so salty that only a few of the alkali weeds can grow and the only way we can get off-shoots and transplanted seedlings to grow is to dig a large hole and fill it with good soil from a nearby mesa. After the plants are once es-

tablished, however, they seem to make a remarkable growth, especially when one considers the conditions under which they are growing.

Growth on the palm is the limiting factor in date production, and it is indirectly through the plant food in the soil that growth is obtained. The palm that makes the largest growth is the palm that produces the largest amount of fruit, but it is not always the palm that produces the largest amount of fruit that produces the best quality fruit. Yield and quality are the two paramount factors in which the date grower is interested, regardless of variety. Without yield the grower cannot possibly hope to justify the high overhead expense of starting and maintaining an orchard. It is estimated that under Arizona conditions it will require a capital outlay of from \$1500 to \$2500 to bring an acre of dates into bearing. Without quality of fruit the date industry can never hope to hold the selling price of their commodity to that point which will justify its production. While it is true that at the present time quality is of secondary importance, as the date is a novelty on the fresh fruit market and the consuming public have not learned to discriminate in favor of the better dates as they have with more common fresh fruits, yet as more and more fresh dates are placed on the market, it is going to be harder to dispose of the inferior grades of dates and the price will vary according to the quality of the product offered for sale.

I believe that there is a possibility of increasing the yield of a palm to a point where quality cannot be maintained, and on the other hand yield can be unreasonably sacrificed for quality. There is a certain ratio between yield and quality, above or below which the date palm will not yield its maximum returns to the grower. This ratio will have to be reached by building up the soil through the use of some form of fertilizer, and as the date palm requires quires a large amount of water, the best fertilizer to use is one that not only adds the mineral elements to the soil, but one that will also increase the water holding capacity of the soil. We have a number of these fertilizers, such as stable manure, green manures, alfalfa straw, and so on. The amount of soil fertilization necessary will depend on the soil in question, and we will never be able to lay down hard and fast rules to cover all types of soils.

At our Tempe orchard we have ob-

tained an average yield per palm of better than 200 pounds of fruit from our Deglet Noor palms. The first planting in the orchard was made 20 feet apart each way and the later plantings 30 feet apart each way. Checks made on the palms in the various parts of the orchard showed that the palms planted 20 feet apart produced on an average of 25% less fruit than the palms planted 30 feet apart. This can be attributed to one of two things: either the palms in the closely planted part of the orchard were not getting the same amount of plant food as the palms in the less closely planted part, or the palms were so closely spaced that they shaded each other to such an extent that they could not function properly. However, since the palms were defoliated, those in the newer part of the orchard have recovered more rapidly, and I am lead to believe that the plant food in the soil was responsible also for the heavier yields in that part of the orchard.

The fact that the orchard has been growing for the past 20 years without fertilization and has produced very good crops with but a few inches of soil in which to grow does not mean that palms do not need fertilization, as many people are lead to believe. In the first place, the soil on which the station is located was some of the richest soil in the Salt River Valley, and since the water table came up the soil has been continually supplied with nitrates and other salts carried in by the water, as is found to be true with most alkali soils. This has had the same effect as applying commercial fertilizers to the soil.

A good example of what soil fertility can do, may be illustrated by some work done on a palm owned by Dr. B. B. Moeur located in the Salt River Valley. This palm had been bearing from one to three bunches of fruit every other year. A trench was dug 8 inches deep around the palm and manure was spaded into the soil in the bottom of the trench to a depth of 5 or 6 inches. Then some well rotted manure was placed in the trench and covered with soil. Since then the palm has produced 4 or 5 large bunches of dates each year with an average of 50% more fruit to the bunch.

Some such method as this could be used to force those varieties that do not produce maximum crops or even to force those varieties into annual bearing that seem prone to bear good crops but once every two years.

Aside from the fact that soil fer-

tilization is needed by some palms and that increase in production can be obtained by building up the soil in all orchards, there is a danger that heavy soil fertilization year after year may be a detriment to the grower in the end. Heavy applications of fertilizers to the young palm will hasten the period of offshoot production and bring the palm into commercial bearing earlier. The date palm will yield its maximum returns for a period of from 10 to 15 years after the palm comes into commercial production. In other words, when the palm gets to be 20 or 30 feet in height, the cost of pollination, handling, and picking the bunches is going to decrease the net returns. The longer the bunches can be kept within easy reach, the great-

er will be the average returns per pound of fruit. Heavy applications of fertilizers year after year after the palm has come into commercial bearing will increase the cost of production in proportion to the amount of growth produced in each palm.

We have found that from 150 to 300 pounds of dates can be produced without fertilization on the average valley soil in Arizona. Also that the yield and quality can be greatly increased or decreased according to the amount of irrigation water applied. This would lead me to believe that the limiting factor in date production is not so much a matter of soil fertilization alone as it is a matter of plenty of irrigation water with light applications of the bulky manures.

In conclusion, I would say that the amount of soil fertilization necessary for a date palm will depend upon the bearing habit of the palm, the type of soil in which it is growing, and the age of the palm. The young palm should be forced by heavy applications of fertilizers until the palm has matured its crop of offshoots, by which time the fruit bunches will hang far enough above the ground to allow free aeration. After the offshoots have been taken from the palm, the amounts of fertilizers applied should be in proportion to the plant food taken out of the soil. The palms should not be forced but made to bear each year good average crops in which the proper ratio of quality and quantity is maintained.

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# Result of Cover Cropping

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BY DR. GEO. SWANN, IMPERIAL VALLEY

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I FEEL, when talking to the date growers of Coachella Valley, about anything in connection with date culture, as though I was carrying coals to Newcastle. You have had so much more experience in that line than I have. However, as your soils are so different from ours, my experience may prove interesting even if not instructive.

The soils in the two valleys may be very different, but I think that probably they are alike in one respect, that both are lacking in humus and nitrogen, and here is one place where cover cropping with leguminous plants is very beneficial.

In 1922 my son and I found our yield of dates was not increasing as it should, and also that the quality of the dates was deteriorating. The dates on some trees in particular that had previously shown evidence of a high sugar content seemed to be lacking in sweetness and flavor. So we went, of course, to our farm advisor, Mr. Garthwaite, and under his direction in the fall or winter of 1922 and spring of 1923 we carried out a series of experiments with three

different cover crops, using sour clover, purple vetch and Canada field peas, planting them in the spaces between the rows of trees, one space of sour clover, the next purple vetch and the next Canada field peas, then the next sour clover, the purple vetch and so on. Just before plowing under in the spring we measured little squares and cut and weighed the cuttings and found the sour clover and Canada field peas ran about 11 to 12 tons to the acre and purple vetch between 9 and 10. The cover crop was planted about November 15th, and plowed under in the latter part of April or beginning of May, if I remember rightly. As a result we found an increased tonnage of dates in the season of 1923 and 1924, also improved sugar content and flavor.

The fall and winter of 1923 and spring of 1924 we repeated the experiment using this time garden peas at first. We did not get a complete stand of peas so in the winter we broadcasted with Hubam clover seed after running a cultivator through the furrows between the rows of

peas. We got a good stand of clover which grew waist high and was plowed under in May. We did not, I am sorry to say, take any test to estimate the tonnage but I am sure it would be equal or better than what we got the year before, that is about 11 tons of growth to the acre. We also hauled in fourteen big loads of manure into the one and two-thirds acre orchard before plowing under the cover crop.

The result of this work, as we see it, was a bigger crop of dates than ever before and a complete return of the sugar content and flavor of those dates that had shown such a marked deterioration in this respect. This last fall we again planted garden peas and we are also getting a fine volunteer crop of clover. We expect also to use all the manure we can secure conveniently and hope in this way to keep the orchard up to the top notch of productivity.

Some day we may try out commercial fertilizer to see how it will compare in cost and in results produced, but just now cover crops and manure seem satisfactory.

# Fertilization of Date Palms

BY C. E. COOK, PRESIDENT OF DEGLET NOOR DATE GROWERS ASSOCIATION, INDIO, CALIFORNIA

I HARDLY know why this subject was assigned to me for I have had little experience in raising cover crops, and have used but very little fertilizer, so the only thing I can tell you is the results without them.

At our place we fertilize with water. We have found that the more water we supply the better the results. We have been increasing the amount of water almost every year and the results have been beneficial. We are now using so much water that it is running back down through the soil 75 feet and indications are that we are pumping it up the second time. That may help solve the water problem.

It may be interesting and profitable to refer to what is done in the old world date gardens. Mr. Dowson, who was Agricultural Director of Mesopotamia representing the British government, says one variety of dates is seldom manured as it tends to make the fruit "squashy" and lowers its market value. Regarding water he gives illustrations of date gardens having 167 palms per acre that are watered twice daily by the tide backing up the fresh water into canals. Each palm has an average of three square yards of water-channel that is saturated twice per day with beneficial results.

In a bulletin by Dr. T. H. Kearny of the U. S. Department of Agricul-

ture he gives an interesting description of the Oued Souf regions of Southeastern Algiers. He describes the soil as pure sand containing very little organic matter even in the older gardens. Yet even with this condition the palms are only manured every twelve or fifteen years; however, these palms are planted with their roots only two or three feet above surface water. Concerning the results, to use Dr. Kearny's own words, "Yet here the date palm grows to perfection, yielding fruit of better quality and in larger quantities than elsewhere in the Sahara."

In other parts of the old world date regions fertilizing is more generally practiced but the above illustrations bring out what I believe to be a fact that the most crying need of bearing date palms is water and even more water and that if a great abundance of water is supplied the amount of necessary fertilizing will be very greatly lessened.

With a great abundance of water assured there is no doubt but it will pay to raise cover crops and fertilize but as has been brought out here this afternoon it is a commercial proposition and we need to study to bring good results without excessive expense.

I have been impressed more and more by what has been said regarding commercial fertilizer. We have

had representatives of different companies come to our Valley to sell fertilizer and almost invariably they have told us that they know nothing of what we will require and recommend that we try various combinations and find out what is most beneficial. That is honest and I think fair for if we undertook the experiment on a large scale there is a possibility of great injury.

Personally I have tried several kinds of commercial fertilizer and haven't been able to see the results. We did not mark the trees—thought the results might be great enough so that we could find them without any record, but that does not seem to be the case.

It seems to me in view of what has forcibly been brought out here this afternoon by experts combined with our own experience that it is safe to conclude that the use of commercial fertilizer for date palms is still in the experimental state and should be used cautiously; and concerning cover crops and other organic fertilizers beneficial results are to be expected provided sufficient water is supplied.

It is an important subject and I hope it will be worked out so we will all get the right results without the injurious effects that are possible.

## Melilotus Indica as a Cover Crop

BY R. H. POSTLETHWAITE, MENAKHER DATE GARDENS, COACHELLA VALLEY

I WAS one of the first to persistently and consistently use cover crops, beginning it eight or ten years ago and all my experience has been very satisfactory, and I have stayed with it. I have always used *Melilotus Indica*, commonly called sour clover, planting it at the rate of 20 pounds of seed per acre. It is very import-

ant to put it in early certainly before October, preferably before September 15th. It grows very slowly during cold weather hence the necessity to get it up three or four inches before winter sets in. It won't grow during the winter, but about the first of February it begins to grow very rapidly and is fit to plow in

on the early part of March, when it ought to be waist high.

The best way to plant is to broadcast half of it, and then furrow the ground and broadcast the other half and immediately water. That method applies to a sand loam, if you are in heavy ground you will probably have to handle it differently. I find

the stand has improved every year, whether that is due to natural increase of inoculation of the soil, I don't know, but I think so. Artificial inoculation is not necessary as the ground has grown mesquite for years which being leguminous has doubtless inoculated the soil. As to water requirements—the average required is from three to three and a half feet during the growing season in about seven or eight irrigations. One experiment which I made though not scientifically correct, is an indication, viz, after five continuous years of *Melilotus Indica* in one plot I had an analysis made and it showed 3-100 of a percent of nitrogen. At the

same time I had an analysis made of another piece of land close to it, and very similar to it, which had never had a cover crop. That showed only 2-100 of a percent. The difference between 2-100 and 3-100 may sound very little actually it means a difference of 870 pounds per acre of nitrogen in the top two feet. I don't claim that the whole of that nitrogen was put in by the cover crop, but I think most of it was due to the planting and proper handling of it.

If you figure nitrogen at 30c per pound the cover crop is worth \$50 per acre per year. In addition to some of that nitrogen there was a

very large addition of humus in the ground. How much I don't know. The decomposition of cover crops, forms carbonic acid which makes the shells available as plant food; if the condition of the soil had originally been such as to make the shell calcium available as plant food the shells would not now be visible, but the presence of innumerable shells in the desert soil plainly shows that while the soil will by analysis show an excess of lime actually the plants cannot utilize it until it is decomposed and the cheapest way to do this is by regularly cover cropping the desert soils.

# Fertilization of Date Palms

BY BRYAN HAYWOOD, INDIO, CALIFORNIA

IT ill-becomes me to try to tell this assembly anything about dates or manuring, but I am going to give you some statistics from the short period I have known about dates.

Two years ago I bought the old French gardens. I am told that the trees, eighty-eight in number, had been well cared for before I got them. They bore in 1922, according to Mr. French's figures, about 60 pounds of dates per tree. In 1923 they bore within a pound or two of 100 pounds to the tree, and, while I am not positive as to the age, they being Yuma palms and of different ages of planting, I think they were five years old in 1922, six years old in 1923. At five years they bore 60 pounds and at six years of age they bore 100 pounds. I fertilized them in the Fall of 1923 with ten tons of barnyard manure, which I had secured from the stockyards in Los Angeles, and also we gave them that same Fall about 20 pounds of potash to the tree.

Last Fall, or this present season, those same eighty-eight trees bore 18,600 pounds of fruit or an average of about 220 pounds to the tree. The most interesting part of that production to me was not so much in the tremendous increase, about 8,400 pounds to 18,600 pounds in 1924, as it was in the percentage of best quality fruit.

I am not familiar with Deglet Noor Association methods of growing nor

the A and B grading. I have never seen the fruit while it was being graded, so I can't compare with the grading by the organization in Los Angeles. However, under the Los Angeles grading this 18,600 pounds of fruit graded 28½% No. 1. That is what I wanted to bring out. I got a higher percentage of No. 1 than any one else who shipped to Los Angeles plant, 52% of No. 2, 2% No. 3.

I have fertilized this past winter with 7½ tons of manure secured from Lovelock, Nevada. I am told it is five times the strength of the manure from the Los Angeles stockyards. At least, those of you who have seen it know there is no straw in it. I am putting on this year, instead of 20 pounds of potash, some 40 pounds of potash to the tree, and I must say that in doing that I have done it in fear and trembling. I also want to say that I have been lead to do this from my own personal experience from my flower garden in Hollywood, and I found out that in actual practice what I have done here worked out well up there.

MR. SHAMBLIN: All the experience I have had is by observation. All I can say is just to add to what these other men have said. Mr. Postlethwaite is the first man I saw try *Melilotus Indica*—sour clover. His results have proven the value of it as a cover crop.

Now, the first experience or observation that I saw of that was on his grapes. He had a run-down vineyard that was bearing only a few hundred pounds of grapes—a few tons, perhaps, but I think it was "pounds"—in the year 1916. If I remember and I don't want any credit for it, but I think I commenced talking sour clover in 1914. I saw the results of the use of sour clover in Arizona in experiment stations in deciduous fruit orchards over twenty years ago. At that time we went to the flour mill and found piles of seed, 30 feet high, blown out of the wheat screenings. The experiment station carried on a great deal of work with cover crops. I think that was about 20 years ago, and we got fine results by taking a run down peach orchard, ten year old trees, and by sowing sour clover seed but not as heavily as Mr. Postlethwaite does. I think the results are better with thinner stand of *Melilotus*. Each root should have a bigger top and a greater amount of foliage than to stand too thick. Postlethwaite's experience on his vineyard was the first thing that attracted me to sour clover here.

I have observed vetches—about three of them—at the experiment station as compared with *Melilotus*, and I think the two go very well together, about 25 per cent of the sour clover sowed into Purple Vetch makes a fine cover crop, possibly bet-

ter than either by itself. Melilotus sowed early will grow fast in the Fall, and will get ahead of the vetch and keep the vetch up. I am strong for cover crops. If the average grower doesn't mind, he will not use enough water for both the cover crop and the fruit. He will find the clover

takes most of the water in the Spring of the year, if he is not careful.

MR. GRIDLEY: One objection to Melilotus Indica is that it has to be sown so early in the Fall that the pickers ruin it before it has a chance to grow. If we could find

some crop that we could plant after the picking season was over, say the first of December, it would be better.

MR. SHAMBLIN: The vetches will do that. That is the proper time to sow them, and mix your sour clover in with your vetch, sowing the first of December.

# Status of the Arizona Date Industry

BY ROBERT C. METZLER, YUMA, ARIZONA

UP to this time there have been only two substantial commercial plantings of date palms in the State of Arizona, aside from the Johnson planting of Deglet Noors at Yuma, which was the first sizable commercial planting in the state, and which planting now constitutes a nursery instead of a fruit bearing property. The value of the nursery at Yuma, which is controlled by Mr. C. E. Cook of Indio, California, can scarcely be over-estimated as an offshoot producing unit. However, no further mention will be made here of that nursery, because it is not a planting of trees which is or will be maintained as a fruit producing garden.

Aside from the Yuma planting, there are only two orchards of sufficient size to justify detailed discussion. One of these orchards is owned by the Arizona Orchards Company and the other by the Phoenix Date Company. Both are located in the Salt River Valley. The Arizona Orchards Company's planting comprises approximately four acres. The planting of the Phoenix Date Company comprises twenty acres. Some of the trees in the Phoenix Date Company's orchard were planted in 1920. Subsequent plantings have been made each year, except in 1924, when no plantings were made. A considerable planting will take place in these orchards and in newly established orchards in 1925.

The plantings of the Phoenix Date Company and the Arizona Orchards Company will no doubt form the nucleus of a great and expanding industry for the State of Arizona. The older trees will fruit in limited quantities this year, and some offshoots will be cut. In 1926 substantial fruiting will occur and a considerable number of offshoots will be available for sale to the public. This will mark

the beginning of an intercourse between Arizona date growers which will continue for many years, and the commercial activities of an Arizona date industry which will endure for centuries.

Of the varieties planted commercially in Arizona, the Hayany takes the lead in numbers, it being planted in greater volume than any other. Next in prominence is the Itima, and third the Maktum. During the year 1925 many young Zahidi trees will be planted, and after that planting takes place the popularity of the various varieties, as evidenced by the number of trees planted, will be as follows: first, Hayany; second, Zahidi; third, Itima; and fourth, Maktum.

It seems curious to those who are unfamiliar with the advent and progress of the date industry in the United States that some of the first imported varieties were planted in Arizona, but that California has by strides extended its plantings, while plantings in Arizona for many years were not made. As a tribute to the Phoenix Date Company and the Arizona Orchards Company, it seems fitting to say that only by unusual energy, enterprise and initiative have they been able to establish for the state a nucleus from which it, and even the State of California and possibly Texas, will eventually draw in building up the date industry of this nation. It should be said also that the United States government is co-operating with the Phoenix Date Company, with a view of eventually delivering to date growers large quantities of Hayany offshoots at exceptionally low prices. It will be interesting for the prospective purchasers of these young trees to know that in about twenty-four months these offshoots will be ready for distribution to the comparatively vast area

in which the Hayany can be successfully grown.

Due recognition should be given to the Department of Agriculture, on account of its interest in Arizona date culture, as manifested by the co-operative quarantine contract with the Phoenix Date Company. Although the offshoots furnished under this contract were in transit four months, with proper shading and good care approximately fifty per cent grew and are now vigorous young trees. As a direct result of this agreement, Arizona is the possessor of the only appreciable supply of Hayany offshoots in America. Soon this source will supply the growers of dates in practically all districts. Small variety contracts have also been made between the Department of Agriculture and several Arizona growers. As a result of these contracts, the merits of many varieties will later be determined.

The University of Arizona is maintaining an experimental orchard near Tempe, Arizona. From this garden has come much valuable information regarding the adaptability of many varieties to the Salt River Valley climate. Two of the outstanding varieties which have stood the rigors of rain are the Hayany and Zahidi. Other varieties have admirably proven their adaptability. From this orchard the University of Arizona has recently made a distribution of offshoots under contract, for the purpose of testing localities and varieties. The results of these contracts will be valuable, and the University should be encouraged in the continuation of this work.

The Arizona date industry is yet new. It is only during the last five years that a genuine effort has been made to establish the industry commercially, make it fundamentally sound, and arrange for the expansion

of it. This, not unlike many other new industries, requires scientific pioneer work. It is a well known fact that certain varieties mature their fruit much better in some date growing localities than in others, on account of the difference in climatic conditions. Thus a geographical division of varieties occurs. It is obvious, therefore, that each locality will have, to some extent, a fruit processing problem with which it alone will be concerned. Much will be accomplished in the matter of

processing fruit, notwithstanding the good results already obtained. Personal enterprise goes a long way, but it has been demonstrated that, in endeavors of this kind, Federal and state agencies can and do achieve greater results than individuals. It would seem that the University of Arizona can do nothing of greater importance in its date work than develop methods of processing and packing the varieties of dates most extensively planted in the state, and lend liberally its co-operation in sup-

port of the new and promising industry.

Much interest is now manifested in Arizona date culture. Expansion will go forward steadily, but let us hope not too fast—that is, not so fast as to include unproved varieties.

In the work of developing this highly interesting and profitable industry, it is a significant and gratifying fact that, by mutual interest, the States of California and Arizona can logically join hands across the Colorado.

# More About the Arizona Date Industry

BY DEAN THORNBUR, UNIVERSITY OF ARIZONA

I CAME over here to have a rest, and I hadn't planned to say anything at all on the date industry in Arizona and I am swept off my feet when you ask me to say anything at this time. Mr. Metzler, perhaps, has set forth the conditions of the date industry in Arizona, very nicely, and I think he has been very fair to the University and all concerned.

As you know the date industry or experimental work in date growing began in Arizona about 25 years ago, and you noted that Mr. Metzler stated that it was only about five years ago that the industry began to attract attention. Now for those 20 years we have been experimenting, and we have made a great many mistakes. I think I may say that some of these mistakes have been so serious that no grower is going to make them again and we hope that he will not. One of the first mistakes that we made, we distributed offshoots to interested persons throughout the valley. I suppose we wanted to be liberal and so we distributed offshoots to any person who wanted a couple, and told him to plant them in his garden or yard for ornamental trees, if he didn't want them for fruit trees. We didn't know how to grow date offshoots. When we cut them off we didn't even know how to do that; and to give them to a man who knew nothing about date offshoots and not being able to tell him ourselves the result was the condition that after twenty years of distributing the date offshoots, one or two percent of those shoots were grown by mistake. That has been a very serious loss to us,

that, of course cannot now be recovered. It wasn't our fault—it wasn't the grower's fault, that is sure. It wasn't entirely our fault except in this. It seems to me we should have started to learn how to root offshoots. We didn't do that. I am not blaming anybody in particular. It was a new business. As Dr. Swingle said, it was working with monocotyledenous trees or plants, and up to this time the white man had been working with dicotyledenous plants and he knew what to do with those, and when he came to the monocotyledenous he knew nothing about it.

Our next difficulty was this. In some way when we brought offshoots over we also imported parlatoria scale, and that got started in our date groves, and we had difficulty in getting rid of it. We tried all methods of extermination and eradication and control, and finally decided upon the matter of torches which originated under Prof. Forbes, and which has proved to be the best method we know of now, not only for control but to eradicate the date scale—parlatoria scale. This scale soon spread over considerable of our date orchards on several occasions in fact this spread was followed by a severe torching and after we had torched we supposed the matter was settled, and we let it go for two or three years, and we found our orchard was re-infested. It was three years ago, I think. We co-operated with the Department of Agriculture and with the State Board of Agriculture, and the Horticultural Department and Universities combined to see if we

could torch and follow up once a month. We took weeks to determine if it were possible to eradicate the parlatoria scale from the tree. To make an important story short, after three years' time so far as we know there is not one parlatoria scale insect in that orchard. I think it has been not only controlled but eradicated. The work has been practical, even though it cost considerable. This leads us to believe that not only the control but the eradication of that scale is possible in Salt River Valley, Arizona, and in all date groves, and that it is a serious handicap in date groves. It was necessary for us to learn this before we felt that the date industry in Arizona could be a commercial success. Suppose a man should get fifteen acres of fine dates, and he could not control the scale after it got in. Where would be his "safe investment."

This is one thing we are proud of. The cooperation with the State Boards of Horticulture and Agriculture, and in cooperation with the Department of Agriculture. Mr. Shamblin here has been in close cooperation and given us every assistance possible.

The second matter was the rooting of offshoots. We had never been able to root more than a few—a small percent of the offshoots ourselves, and the people who received them from us had a small percent. We undertook some concentration work on this three years ago, and we are able to say now we are rooting something like 90 per cent of the offshoots that we are cutting from our trees, and

where we root these above the trees, before we cut them we save a larger percent; but we have the advantage in this respect that within a few years with the small number of dates we now have that are bearing offshoots, we shall have many more offshoots for putting out on farms under contract to determine variety best suited to the Salt River Valley, and to determine the locality where these varieties do best.

We have also made progress in our processing. I agree with Mr. Metzler that that is one of the big things we can do now, that is the work of processing the varieties of dates that are particularly well suited to Arizona, for we do not now know how to process, and put on the market in the best condition. I am very glad to have this suggestion come from Mr. Metzler. The policy of the experiment stations has been for two years the encouragement, as fast as possible, of commercializing the date production in Arizona, and to determine the areas in the state that are believed to be date producing areas. We have had considerable interest in Southern Arizona, and there are other parts in which we believe we can produce one variety or another of dates commercially, and we are interested in working those up. We are interested in extending the com-

mercial plantings in the valley where they are now, and wish we had a dozen or two dozen men like Mr. Metzler and Colonel Bumstead. We need more men who have means, and who have foresight to work with us in establishing this date industry in Arizona.

I believe, in times to come, we shall be the center of the date industry in America, and we are working toward that end. We have a splendid climate, most excellent soil, and plenty of irrigating water—most of the time.

We are not out of the woods on our problems. Some of them confront us yet, although I think they are not serious, but they have to be settled and the experiment station will endeavor to take these problems up as fast as possible for the Arizona growers as well as for the California growers. I thank you.

MR. HAMILTON: (In charge of Yuma Experimental Station.) In spite of the fact we have one of the oldest plantings at Yuma, and the only Deglet Noor nursery in the world, Yuma has been backward in coming forward. Today, I think we have seven or eight from Yuma, but only one besides myself that is really planning on going into dates. They are waking up though. A few men like Colonel Bumstead and Mr. Metzler have done more to awaken a real in-

terest in date growing in Arizona than any one.

We have many calls for the pamphlets of the Date Institute of last year, and we had hoped to have quite an attendance today. I should have gotten up when Mr. Gridley was talking about piling up dirt around the palms. We are not experienced in putting dirt around palms at Yuma. Wind doesn't blow there, so our trees don't blow down, but we do have to look out for gophers. Possibly they are not as active in your dates as in your citrus groves.

In the Yuma Valley we have gophers. If you clean them out today, they will be back tomorrow. If you have piled dirt around your palms you are going to have gophers under the roots near the surface. I don't think you have Bermuda grass here like we do there, so that is one point.

We think—especially with small palms—that we can lower them cheaper than we can pile dirt around them, and encourage the gophers to get in there and kill the trees.

We don't know when we will be able to invite you people to Yuma, but we hope we will have the Date Institute over there, unless you are going to have a permanent Institute here—if you want to be selfish—if so, we will come over as often as possible and help you make it a success.

## Value of Wax Wrappers for Carton Packed Dates

BY ARTHUR W. CHRISTIE, ASSISTANT PROFESSOR OF FRUIT PRODUCTS,  
UNIVERSITY OF CALIFORNIA

WHEN freshly processed moist dates are placed on the market in ordinary paper cartons, they become subject to three types of deterioration which gradually lower their quality and, in time, may make the dates entirely unmerchantable. Briefly described, these three types of spoilage are:

1. Gradual evaporation of moisture from the dates, resulting in:

- (a) Loss in net weight of container.
- (b) Development of a dull, unattractive appearance.
- (c) Development of a dry, hard, unpalatable product.

2. Gradual formation of sugar crystals caused largely by evapora-

tion of moisture. These sugar crystals injure both the appearance and palatability of the dates.

3. Insect infestation, resulting in contamination and partial consumption of the dates to an extent which makes the product unsalable.

There is also another type of spoilage, known as souring, caused by partial fermentation of the sugar. Such souring is readily prevented by subjecting the fresh dates to sterilization at about 165 degrees F., or to partial dehydration at lower temperatures. Either or both of these methods together have been shown to effectively prevent souring. The heat of dehydration or sterilization also

destroys all insect life which may be in or on the dates.

If properly processed dates are packed in protective containers, they should retain their quality until consumed, which may be as much as a year after packing. Vacuumized, hermetically sealed glass jars have been found to be ideal containers, especially for the fancy grades, but for a large part of the pack, paper cartons are more convenient and less expensive. However, ordinary paper cartons, either of the "tuck end" or "candy box" type, are not impervious to either moisture or insects. So far, little trouble has been experienced by California date packers from spoilage

of carton packed dates. This has been due primarily to the fact that the dates have gone into consumption rapidly during the fall and winter. With rapidly increasing production, it is inevitable that a considerable part of the pack will not be consumed until the following spring and summer. This means that not only will part of the pack be subject to possible spoilage over a longer period but the latter part of this period will come during warm weather when the agencies of spoilage are most active. Therefore, in order to protect the fine reputation of California dates and to increase the demand for this domestic product, it is imperative that dates be marketed in containers which will insure their reaching the consumer in satisfactory condition, even after many months.

Self sealing wax paper wrappers are used on a great many products to prevent or greatly retard undesirable changes similar to those mentioned above. These wrappers are easily applied to the filled package either by hand or automatic machines at a very nominal cost. In order to ascertain the efficiency of such wrappers for carton packed dates, the following test was conducted:

#### Plan of Test

Six 10-ounce cartons of standard grade freshly processed dates were obtained from a leading grower and packer of California dates. Three cartons were wrapped in self-sealing wax paper furnished by the Kalamazoo Vegetable Parchment Company of Kalamazoo, Michigan. The other three cartons were left unwrapped. All were placed in a storage room at ordinary temperatures. This room contained active moths and beetles of the kinds which attack dried fruits. The cartons were weighed and examined at intervals of a month or more for a period of over one year.

#### Examination of Dates

The dates in the wax wrapped cartons suffered no insect injury whatever, sugared very slightly, and, although a little dry, were of excellent appearance and flavor after eighteen months' storage. Although not equal to freshly packed dates, they were entirely merchantable.

The dates in the unwrapped cartons were almost entirely decomposed by insects and contained many, both live and dead, insects. They were also very dry and badly sugared and entirely unmerchantable.

#### Results of Test

1. Loss in weight: The following table shows that wax wrappers, while not entirely impervious to moisture changes, do greatly retard moisture evaporation, especially during the first six months after packing. The original weight of each carton was 286 grams net and 324 grams gross. (1 ounce equals 28 grams).

Average loss in wt. (grams)		
Days Stored	Wrapped	Unwrapped
17	1	5
46	4	12
83	5	16
184	11	23
303	14	18
400	12	15
493	14	20

The fluctuations after the first six months are mainly due to variations in seasonal air humidity with which the moisture content of the dates seeks to establish equilibrium.

#### Conclusion

Wax paper or similar wrappers are of great value in preventing insect injury, drying and sugaring of carton packed dates and their proper use insures the dates reaching the consumer in acceptable condition.

## Pruning the Date Palm

Dr. SWINGLE: Formerly, date leaves were something that got in the way of the horses and interfered with cultivation and the big discovery was a tool to cut them off with. We have now the finest machine to cut them off with. It makes a nice crisp sound as they come off. Listen to this nice sound (operating tool). Probably 25 leaves were taken off each year for six years, six times twenty-five is one hundred and fifty leaves were pruned off, or you might say, 150 pounds of sugar gone, as each leaf is supposed to make a pound a year for each leaf for six years by this little exercise.

The leaving the leaves on the trees to make fruit, and leaving leaves on the offshoots to make starch, are fundamental matters in date culture.

The pruning matter that I want to outline is one that goes back apparently to whether you ever went barefoot. The inhabitants of the date regions of the old world didn't wear shoes. We supposed, naturally, when they climbed a tree they didn't like to put their feet on sharp leaves

so they cut them off even. That was not the reason, however. If you don't prune off the leaf base, a growth starts from the tree and decays, and a layer on the outside is shoved off, and the tree is ruined. Here is a piece (indicating a big piece of trunk) torn off, that is the original leaf bearing area. That junk isn't some superfluous part that has been discarded, but it has been destroyed by improper formation of roots, and here you can see this root formation has been improper (indicating). There is a root growth that isn't so bad, that layer of trunk can be sacrificed and still grow dates, but something worse happened, and this was thrown off by a mass growth out from the trunk of the tree and pushed that great layer off. Those roots are two or three feet above ground, finally died and they in turn rot; as they decay another root growth starts.

The white race is not familiar with monocotyledonous trees. White people never lived where they had to deal with monocotyledonous trees.

They know grasses and lilies. Our Northwestern European ancestors have not helped us any with monocotyledonous trees which do not grow like apple or pear trees. Root growths occur on a monocotyledonous tree like this (indicating). This peculiar growth on date palms is practically ulcerations like a man growing a fine crop of boils, and has the same effect on the trees as the boils do on a man. The result of that is, first growth of roots starting in trunk. This pressure takes the coating off the trunk of the tree, then comes the second growth of carbuncles and pushes the decayed material off. Each time the diameter of the tree is reduced. On a date palm 14 inches or 15 inches in diameter, it was reduced each time until you have finally a six inch neck connecting the root with the top of the tree. Some of our severe winds will take off the top of the tree. It often happens that the yield of the fruit starts diminishing long before the tree has gone over due to the

imperfect connection of the roots with the top.

I want to call your attention to the fact that the value of your investment depends upon your study of this pruning. Let the leaves live and finally die, then cut them off. After you cut them off your trouble begins. You have a leaf base then. The ordinary method is to leave it long like this (indicating). The normal date trunk unobstructed by root growth is shown here (indicating). This bundle here, if you would pound this you would get something like a brush, it is the fibrous part of the date stem. It originates on the inside of the trunk and grows out (indicating). This root growth begins after the leaf base dies and pushes off the upper layer. Here is a sample off a Deglet Noor where the leaf base came off nicely, and excessive roots were cut off above the soil and when the roots came out I cut them off, and made a nice job of it. Yesterday I found this was standing out like that (indicating), and a nice crop of roots were starting in there.

This root formation occurred one or two inches in the trunk. Don't be discouraged if the roots keep on forming for a year or two after you start pruning. They will stop in time.

This is, I think, all I care to say now, about this pruning of leaf bases. Prune them, but prune them at the right time. Don't cut your leaves too soon, else they will check and split. Leave a stem that long (indicating) and when that stump dies, saw it off evenly; then, if you happen to leave it too long, the bottom becomes sappy, and the top dry—that sappy leaf base dies until it is dead clear to the bottom. You finally trim it two to four inches above the stem, near enough to the base so the stem will stay permanently dry, then, if that is done properly, you will prevent all bursting of the roots. We have proof of that out in the Mecca Gardens. In 1914 the root growth had started on this from about 8 inches above the surface to a foot and a half above the soil. Thereupon we pruned those leaf bases nicely for another two feet then by '24 the roots started to break out above this pruned area so it has two big masses or roots like that—one below and one above. It was pruned in 1914, which shows conclusively that proper pruning will prevent this. It does not cost much. We have it down to about the same as trimming the spines.

MR. GRIDLEY: Now as I see this

pruning question there are two kinds of date pruning, one is leaf and one is trunk. I know very little about either kind—we tried both, and as Dr. Swingle pointed out we pruned the palms first so that the mules could get by better, and I know we all carried it to excess. Now we prune as little as possible, and we prefer to take a wire and put those leaves out of the way and let them grow as long as possible. You all realize that it is necessary to take off one now and then.

The trunk pruning is a different matter, and a more serious one. We were warned by Dr. Swingle two years ago that we would have to trunk prune our trees to keep them from going over. We paid little attention to it. Finally we realized that we would have to do something mighty quick. The roots were forming at the base of the tree sometimes for three feet up the trunk, pushing off the leaf bases. Last June we pruned 100 palms. They looked nice and pretty and clean, the root bases dried up; in October and November three of them blew over, and we had to get out next morning with a block and tackle and a gang of Mexicans and haul them back into position and put guy wires on them; some of them had four guy wires on them. So it seems that trunk pruning was not so good after all. Now what does trunk pruning do to those palms, and what can we do to save our palms from being consumed by roots that come out at the base or from being blown over? I have solved it to my satisfaction by banking up earth around those trees and I don't know whether that is good or not. We banked up the earth around them and are awaiting future results. Practically everyone of those contain roots three to four inches long, a mass of them, and it looks like those trees are going to anchor themselves. What will happen if they become a mass in there, we don't know.

A VOICE: I would like to ask if those bases you provide for your palms take up water to the top of the base so those roots have plenty of chance to feed, or does the water reach the top naturally. Does the top of the earth come above the water?

MR. GRIDLEY: At the present time the top of those mounds are eight inches above the water line. Roots are coming out in the dry soil.

DR. FARIES: In rooting my offshoots I was brought face to face with this subject of guying my palms,

We cut ten offshoots off one palm. I put a circle of building paper around and enforced that with chicken wire, and I had to cut the chicken wire off with Pliers because in the mess I made at the bottom they got out and went through and anchored themselves, so it is in good condition now. That was ten years ago.

DR. SWINGLE: I would like to call attention to the case of Deglet Noor date palms. There are two kinds of roots. Many of them have had experience only with Deglet Noors. The leaf bases are first consumed by the smaller roots, which grow horizontally or vertically. They have no tendency to grow down. Many Deglet Noors are surrounded by a large mass of upward growing roots and they are called "breather roots" by the farmers. They are the first group, and these breather roots on the Deglet Noor absorb the decaying leaf bases. After they have absorbed and dried up to some extent the second crop of roots grow. They have different diameters—half inch diameters, apparently the rectangular or horizontal or downward growing feeder roots, so you must distinguish between these two roots in the Deglet Noor. The Theory has almost none of those vertically growing roots, near the trunk. So there is a question of variety involved. The Deglet Noor does not throw off its lower bark as quickly as some, does not need pruning as badly as some do, but if you don't do it they will probably blow over.

MR. CARR: What kind of root is this? Lateral root or feeder root.

MR. GRIDLEY: Straight lateral root growing downward.

MR. GARTHWAITE: I didn't understand whether you said your palms were high set or low set, and whether in your opinion palms low set would have the same tendency to blow over as the high set ones.

MR. GRIDLEY: Nearly all date growers made the common mistake of settling palms too high in early plantings, and that is the reason, I think, why a great many are weakening now. When the offshoots were removed it left the palms in a weakened condition. When these roots came out, and were pruned back, that further weakened the trunk and reduced the area. That is why they blew over; those of us who practice deep setting, if we set deeply enough and maintain open basins until the offshoots are off, perhaps eight years in Deglet Noors, we can overcome this difficulty. We can then fill in

around the palm and it will produce new roots, and thereby anchor itself.

MR. HEINY: It depends on whether your soil is heavy or not. I mean to say there is a difference in the soil how you plant. I planted a palm alongside an irrigation ditch and the roots ran right out into the moist soil of that ditch. So, if the soil is moist, the roots will grow more rapidly than where the soil is dry.

MR. GRIDLEY: I think that is true, where you have porous soil it might be better to plant deeper down, but in heavier soil your palms want to be planted higher up.

You think irrigation water has something to do with that?

MR. HEINY: Of course, date palms require air. Any palm does, and you just put it down, and put another palm up higher alongside, you find difference in the growth and color of the plant in the leaves.

MR. GRIDLEY: Irrigation is a subject that we didn't feel we would bring up this time but there is a relation in the way the palm is watered and the way it develops. I never have been an advocate of the flooding system. You should only

do that on land where it is well drained. It is necessary for the palm roots to breathe. It is only in the last couple of years that we found this.

DR. SWINGLE: Many growers are relying too much on the basin to prevent these root growths. Long before you are aware of it ulceration is beginning in the trunk and the palm planted in a basin 16 inches deep, the trunk looks sound, but if you cut into a section you will find the roots already started, a foot above the level of the ground. It is high time to begin pruning of the leaf bases before the basin is built up. I don't mean to prune clear to the ground, but it is necessary to stop this formation. I have shown by this instance of pruning which I did last June that did not stop it in the dry area, as the roots continued to force out through the dry layer. Roots started by Spring a year ago, so it is important to experiment to be sure they can stop this growth where they want to.

MR. GRIDLEY: I have been conceding that these roots do not start until the palm has reached a certain age. If I am wrong, I want to know

DR. SWINGLE: As soon as the offshoots are off and as soon as the lower leaf bases begin to decay roots form. As soon as it is dry then the root growths start immediately 2, 4, 6 inches up the trunk in your basin and especially when there are no offshoots on your tree. You want to look out.

MR. GRIDLEY: That would fit in with Dr. Faries' statement, not to cut the leaves from the palm. As long as they are uncut, the roots will not form. In the case of some other varieties, Hayany, Khadhrawi, Halawi and a few others, on which offshoots do not mature as early, then you need not remove the offshoots as early. We are faced with this condition. We have offshoots not ready to come off on nine year old palms and yet this root formation has proceeded to an advance stage. What will we do? Either have to strip the offshoots off before they are mature or we will have to try to chisel around and remove such as we can get at.



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